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Assessment of Seasonal Variation in Physico-chemical Quality And Pollution Status of Kangsabati (Kasai) River, Purulia District, West Bengal, India

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ABSTRACT:

Purulia is situated on the north of the Kangsabati (also variously known as the Kasai) river. Now, river has been subjected to massive degradation and pollution due to the enormous quantity of household as well as industrial wastewater inflowing the river. In the present paper an attempt has been made to investigate Physico-chemical quality of water and pollution level of Kangsabati River during six months (January, 2014 to June, 2014). For this investigation the water samples were collected from pre-selected sampling stations and status of parameters such as pH, temperature, turbidity, conductivity, DO, BOD, COD, total alkalinity, total hardness, chloride, phosphate, nitrate-nitrogen, iron, ammoniacal nitrogen, sodium and potassium were examined by standard methods. Present study revealed that pH (7.6 - 9.3), Turbidity (27.6 - 38.3 NTU), Dissolved oxygen (3.70 - 7.60 mg/l), Biochemical oxygen demand (6.24 - 9.8 mg/l), Chemical oxygen demand (68 - 148 mg/l), phosphate (0.23 - 0.70 mg/l), ammonia (0.38-0.96 mg/l) and potassium (61.8-154.8 mg/l) were observed beyond the permissible limits. The value of temperature (18°C- 26°C), conductivity (0.16 - 2.58 µmhos /cum), total alkalinity (103 - 154 mg/l), total hardness (86 - 184 mg/l) chloride (88.2 - 172.6 mg/l), Nitrate-N (0.26 - 0.78 mg/l), Nitrite-N (0.06 - 0.58 mg/l) Iron (0.18 – 0.26 mg/l) and sodium (78 - 138 mg/l) were under the permissible limits of WHO and BIS. Depending upon the value observed from this study, it was noticed that water of Kangsabati River is somewhat polluted due to discharges of industrial waste, domestic sewage and agricultural run-off, and various human activities in the catchments of the river, which need more efficient management and regular monitoring to improve the quality of this river.

Key words: *assessment; seasonal variation; physico-chemical quality; permissible limit; pollution status*

Introduction

Water plays an important role in human life. For development of a country, river has an important role as a source of water supply to achieve household, industrial, agricultural, and many more. Mostly agriculture in India fulfil its' demand of water from various surface sources like river, reservoir, dam, *etc.* (Thitame and Pondhe, 2010). It is also noticed that river also utilized as sink of domestic and industrial wastes which ultimately leads to water pollution (Kumar, 2002). Though river water has some self purification capacity, but in most cases the quantity and quality of wastes and effluent discharged exceeds the purifying capacity (Aggarwal, Singh, and Gupta, 2000). Various industrial wastes and domestic sewage are the main causes of pollution in river, because it changes the physical and chemical properties of river water and the quality for various uses (Karthi and Divvakar, 2008). Begum and Harikrishna (2008) reported increased pollution load due to the movement of chemical fertilizers, agricultural runoff, industrial effluents and anthropogenic wastes at river Cauvery. As per previous report (Sangu and Sharma, 1978) almost 70% of the surface water in India becomes polluted for discharge of domestic sewage and industrial effluents into rivers, streams as well as lake. Gupta and Pankaj (2006) reported organic pollution in River Gomati due to anthropogenic operations. Kangsabati River (also known as Kasai) rises from the Chota Nagpur plateau in the state of West Bengal and passes through the districts of Purulia, Bankura and Paschim Medinipur in West Bengal to drain in the Bay of Bengal at Haldia. In present study an attempt has been made to measure the spatial and seasonal variation of physico – chemical properties and the change in quality of Kangsabati (Kasai)river water for drinking and purposes of Purulia district in West Bengal.

Materials and methods

Considering the water flow and discharge of household waste into river, four sampling sites (Teledih, Shimulia, Uchali, and Dumursol) were selected at random on the river Kangsabati. These sites were recognized as Site 1, 2, 3, and 4 respectively; which included upstream and downstream points of the river. Samples were collected about 10 centimetre depth from these spots during January – February, 2014 (winter) and May – June, 2014 (summer). Two litres sample water from these sites were collected in sterile plastic container, placed

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in an ice box and transported to the laboratory for immediate analysis. The temperatures were recorded at the site itself with the help of thermometer in °C. To measure the status of parameters like pH, temperature, turbidity, conductivity, DO, BOD, COD, total alkalinity, total hardness, chloride, phosphate, nitrite – nitrogen, nitrate – nitrogen, iron, ammoniacal nitrogen, sodium and potassium, filtered samples were used as per standard methods (APHA 2005). The quality has been assessed by comparing each parameter with the standard desirable limit of that parameter as prescribed by ISI 10500-91, and BIS- 1991.

Results and discussion

The water quality parameters are summarized in Table – 1 and Table – 2. pH is an index which determine the intensity of acidity or alkalinity and the concentration of hydrogen ion in water. Present study shows that pH of water samples varied between 7.6 and 9.3. Turbidity makes water unfit for domestic purposes, food and beverage industries and many other industrial uses. In the present analysis, turbidity values varied between 27.6 - 38.3 NTU. Electrical conductivity indicates the amount of total dissolved salts (Rao and Venkateswarlu 2000). EC values were observed in the range of 0.16 - 2.58 µmhos /cum. Dissolved oxygen reflects the physical and biological processes prevailing in the water which indicate the level of pollution present in water bodies. In the present study of water samples, DO value varied from 3.70 - 7.60 mg/l.

As per previous (Rao and Venkateswarlu 2000) work report, the main sources of natural alkalinity are rocks may also contribute to alkalinity. Here the range is 103 – 154 mg/l. Hardness in water is due to the natural accumulation of salts from contact with soil and geological formations or it may enter from direct pollution by industrial effluents. In the present study, total hardness varied from 86 – 184 mg/l. Iron is considered as essential micronutrient. Prolong consumption of drinking water with high concentration of iron may leads to liver disorder (Gyamfi et al. 2012). The iron concentration was recorded in water samples in between 0.18 and 0.26 mg/l. The most important source of chlorides in the waters is the discharge of domestic sewage (Patil and Patil, 2011). In the present analysis, chloride concentration was found in the range of 88.2 - 172.6 mg/l. The nitrate content in the study area varied in the range of 0.26 - 0.78 mg/l. Present study revealed that pH ,Turbidity, Dissolved oxygen, Biochemical oxygen demand (6.24 - 9.8 mg/l), Chemical oxygen demand (68 - 148 mg/l), phosphate (0.23 - 0.70 mg/l), ammonia (0.38 - 0.96 mg/l) and potassium (61.8-154.8 mg/l) were observed beyond the permissible limits. But the mean value of temperature (18°C - 26°C), conductivity (0.16 - 2.58 µmhos /cum), total alkalinity (103 - 154 mg/l), total hardness (86 - 184 mg/l), chloride (88.2 - 172.6 mg/l), Nitrate-N (0.26 - 0.78 mg/l), Nitrite-N (0.06 - 0.58 mg/l) Iron (0.18 – 0.26 mg/l) and sodium (78 - 138 mg/l) were under the permissible limits of BIS. Depending upon the value observed from this study, it was noticed that water of Kangsabati river is somewhat polluted due to discharges of industrial waste, domestic sewage of indigenous people, agricultural run-off, and various human activities (unsustainable development) in the catchments of the river, and from figure – 1, it is noticed that during summer, it shows maximum value (degree of pollution) than winter, may be due to lowering the perennial flow. So it needs more efficient management and regular monitoring to improve the quality of this river. The Kasai river water is very precious in this region. The river water should be properly treated besides to get the safe and sound water supply in this region.

Table 1: Water quality status during winter (January – February, 2014)

Parameter	Site – 1	Site – 2	Site – 3	Site – 4	Mean
pH	7.6	7.7	7.5	7.6	7.6
Temperature (°c)	18.7	18.3	17.8	17.2	18
Turbidity (NTU)	26.9	27.4	27.8	28.3	27.6
Conductivity (µmhos /cum)	0.17	0.16	0.17	0.14	0.16
Dissolved Oxygen (mg/l)	7.5	7.7	7.6	7.6	7.6
BOD (mg/l)	6.28	6.16	6.27	6.25	6.24
COD (mg/l)	73.0	61.0	67.0	71.0	68.0
Total Alkalinity (mg/l)	94.0	102.0	113.0	103.0	103.0
Total Hardness (mg/l) as $CaCO_3$	88.0	82.0	93.0	81.0	86.0
Chloride (mg/l)	84.8	86.2	84.2	89.6	88.2
Phosphate (mg/l)	0.52	0.68	0.78	0.82	0.70
Nitrate – Nitrogen (mg/l)	0.21	0.25	0.28	0.30	0.26
Nitrite – Nitrogen (mg/l)	0.04	0.07	0.05	0.08	0.06
Iron (mg/l)	0.17	0.18	0.19	0.18	0.18
Ammoniacal Nitrogen (mg/l)	0.83	1.02	0.98	1.01	0.96
Sodium (mg/l)	71.0	79.0	84.0	78.0	78.0
Potassium (mg/l)	58.3	59.6	64.2	65.1	61.8

Table – 2: Water quality status during summer (May – June, 2014)

Parameter	Site – 1	Site – 2	Site – 3	Site – 4	Mean
pH	9.2	9.3	9.1	9.6	9.3
Temperature (°c)	25.4	25.9	26.2	26.5	26
Turbidity (NTU)	37.8	38.4	38.6	38.4	38.3
Conductivity (µmhos /cum)	2.46	2.47	2.62	2.77	2.58
Dissolved Oxygen (mg/l)	3.7	3.5	3.8	3.8	3.7
BOD (mg/l)	9.6	9.3	10.2	10.1	9.6
COD (mg/l)	144	142	155	151	148.0
Total Alkalinity (mg/l)	132	156	167	161	154.0
Total Hardness (mg/l) as $CaCO_3$	153.0	173.0	181.0	199.0	184.0
Chloride (mg/l)	156.6	172.2	181.5	180.1	172.6
Phosphate (mg/l)	0.24	0.19	0.23	0.26	0.23
Nitrate – Nitrogen (mg/l)	0.76	0.78	0.81	0.77	0.78
Nitrite – Nitrogen (mg/l)	0.58	0.55	0.58	0.61	0.58
Iron (mg/l)	0.22	0.26	0.29	0.27	0.26
Ammoniacal Nitrogen (mg/l)	0.36	0.38	0.42	0.36	0.38
Sodium (mg/l)	131.0	139.0	144.0	138.0	138.0
Potassium (mg/l)	143.7	159.2	156.1	160.2	154.8

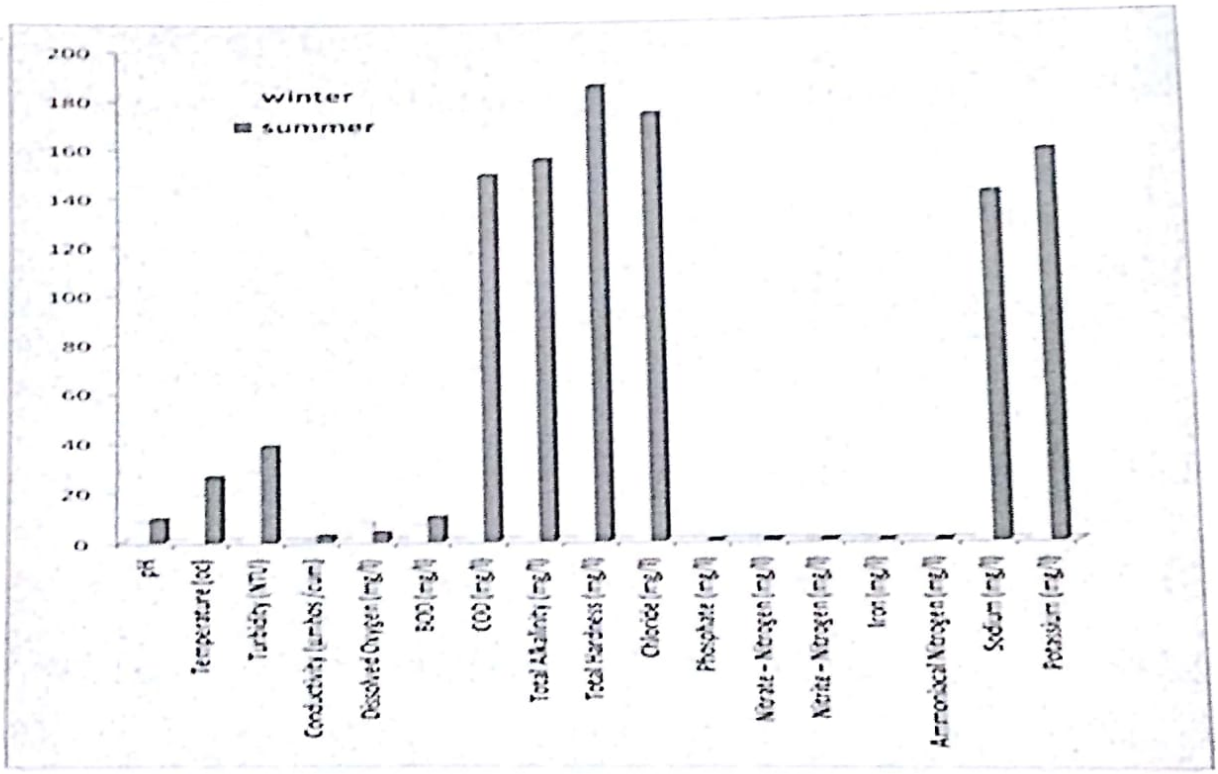

Fig – 1: Seasonal variation in physico-chemical quality and pollution status of Kangsabati (Kasai) river, Purulia

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